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Group Report**1964-40****H. E. Frachtman****Haystack Pointing System: Sun****29 July 1964**

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Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Lexington, Massachusetts



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MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LINCOLN LABORATORY

HAYSTACK POINTING SYSTEM: SUN

H. E. FRACHTMAN

Group 62

GROUP REPORT 1964-40

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LEXINGTON

MASSACHUSETTS

ABSTRACT

This memorandum describes the method used by the Haystack pointing computer program for obtaining the celestial coordinates of the SUN at any time.

Accepted for the Air Force
Franklin C. Hudson, Deputy Chief
Air Force Lincoln Laboratory Office

I. INTRODUCTION

SUNTRACK is a program in the Haystack Univac 490 pointing system whose output is the celestial coordinates of the Sun at a given time. The program computes the coordinates by 3rd difference interpolation in the tables of the apparent right ascension, declination, and radius vector of the Sun published in The American Ephemeris. The rates of change of the three quantities are computed by numerical differentiation.

II. INPUTS TO PROGRAM

A. Inputs Furnished by Core Memory

The program uses the registers listed in Table I for input information. The year and day are used to select the appropriate entries from the Sun's ephemeris. The coordinates of the Sun are interpolated for the time which is the sum of the times in CELTIME AND DELTATEE.

B. Inputs Furnished by Magnetic Tape

The tape format of the Ephemeris for the Sun, which has been edited and recorded by a 7094 program described in Reference (1), is shown in Fig. 1. Each block of 288 words covers a period of 32 days. The ephemeris for each day required 9 words. The program does not make use of the semi-diameter or the year-month-day words in the block. The tape must be on Unit 1 (normally Servo B).

III. PROGRAM OUTPUTS

A. Outputs Left in Core Memory

The apparent celestial coordinates of the Sun, corresponding to the time in the register CELTIME, together with their numerical derivatives, are stored in the appropriate registers, as illustrated in Table II.

B. Typewriter Outputs

During initialization the SUNTRACK program will type, using the INTERCOM subroutine, certain information concerning the SUN. Items printed are:

<u>Register</u>	<u>Contents and Scaling</u>
W(CELTIME)	Days B28
W(DELTATEE)	Days B28
U(YEARMONTH)	Year B15 (4 decimal digits)
L(YEARMONTH)	Month B0
L(DAY)	Day of Year B0

TABLE I
Core Memory Inputs to SUNTRACK Program

NOTE: Notation "B28" means that the binary point is to the right of bit 28.

I. D.	10_d	Conventional Day Number	0
All Zero	Year	Month	Day
14	8	4	0
Right Ascension	B26	radians	
First Difference	Right Ascension	B26	radians
Declination	B26	radians	
First Difference	Declination	B26	radians
Radius Vector	B28	Astronomical Units	
First Difference	Radius Vector	B28	Astronomical Units
Semi-Diameter	B26	radians	

Fig. 1. Magnetic Tape Format for SUN Ephemeris

W(RA)	Apparent Right Ascension B27 in revolutions
W(DEC)	Apparent Declination B27 in revolutions
W(RADIUS)	One's complement of distance from center of earth to surface of Sun B24 in Astronomical units
W(RADOT)	Numerical Derivative of Right Ascension B37 radians/sec.
W(DECDOT)	Numerical Derivative of Declination B37 radians/sec.
W(RADIUSDOT)	Numerical Derivative of Radius Vector B24 nautical miles/sec.

TABLE II
Core Memory Outputs of SUNTRACK Program

1. Julian Day corresponding to values in YEARMONTH, DAY, and CELTIME (7 digits).
2. Apparent Right Ascension of SUN (Hours, Minutes, Seconds to hundredths).
3. Apparent Declination of SUN (Degrees, Minutes, Seconds to hundredths).
4. Day of Year (Up to 3 digits).
5. Universal Time for which the coordinates are interpolated. It is the time in CELTIME at initialization (Hours, Minutes, Seconds to hundredths).
6. The distance between the centers of the Earth and Sun (Astronomical Units to hundred millionths).
7. The work "SUN".

If, after a search through 9 files on Unit 1 (or the finding of an end of tape mark), the sun ephemerides are not found, the program will type "SUN EPHEMERIS FOR X/Y NOT AMONG FIRST 9 FILES" and will exit to the master control program error return. "X" and "Y" indicate the current month and year, respectively.

If there is a tape servo malfunction during search, the program will type "IIIC STATUS S1 ZZ" and will exit to the master control program error return. The two digit octal number "ZZ" comes from the tape status word and indicates the error condition.

IV. ASTRONOMICAL SIGNIFICANCE

The apparent right ascension and declination of the SUN in the ephemerides are referred to the true equinox and equator of date and are corrected for planetary aberration. They are geocentric apparent quantities; the parallax correction is made by the coordinate conversion program (COCON) in the Haystack system. The values in the tables are computed for Ephemeris Time as argument. The equation

$$ET = UT + \Delta T$$

is used to convert from Universal Time to Ephemeris Time. The constant ΔT , represented by the number in the register DELTATEE is approximately 35 seconds.

The radius vector is the actual geometric distance in astronomical units between the centers of the Earth and Sun at the stated time.

The number 934.91 is used to convert astronomical units per day to nautical miles per second in the computation of the number in RADIUSDOT.

$$934.91 = \frac{499.005 \times 2.997925 \times 10^5}{1.852 \times 86400}$$

499.005 = number of seconds per astronomical unit

2.997925×10^5 = velocity of light in kilometers per second

1.852 = kilometers per nautical mile

86400 = seconds per day

A comprehensive explanation of the ephemerides is given in Reference (2).

V. PROGRAM DETAILS

The SUNTRACK program is a subroutine of the Haystack Univac 490 pointing program. The initialization section begins at SUNINIT, the working section at SUNCONT. There are several closed subroutines within SUNTRACK. These are: DAYFIND, STATUSCK, INTERPOL, LEFRNDOFF, and ROUNDOFF. A listing of the program is given in Appendix I.

A. Initialization

The program, upon initialization, stores an RIL instruction in the tape channel internal interrupt register and an RJP STATUSCK instruction in the external interrupt register. The area in core into which the tape data will be read is cleared, together with some additional registers. This is done to make diagnosis easier in case of malfunction.

The SUN Ephemeris entries are serially numbered by the program which generates the magnetic tape (Reference 1). These serial numbers are called "Conventional Day Numbers" (CDN). An arbitrary decision was made to produce and use tapes such that the CDN for 25 April 1963 is zero. The tape search process looks at the first word in each block, therefore, the SUNTRACK program must compute the CDN of the first word of the block containing the entry for the required day.

Using as inputs the year, day of year, and the effect of integral and half-integral values of CELTIME, the program computes the Julian Day number for the typewriter. The ephemerides start and run continuously from 25 April 1963, which has a Julian

Day Number of 2438144.5; this number is subtracted from the computed Julian Day number to find the Conventional Day Number. (It is 6 for 1 May 1963, the first day for which ephemerides tapes were made for the system.)

The first CDN in each block will be given by $6 + 32n$ where n is a positive integer or zero. The first CDN in a block is stored in TAPEBLOCK (lower half) and the SUN identification number 10_d is added to generate a tape search comparison word, stored in TAPESEARCH and also in SAFE.

The number in SLOTBLOCK represents the number of the entry in the 32-word block.

If $1 < \text{SLOTBLOCK} \leq 29$, only one block need be read in; if not, either the preceding or following tape block should also be read to provide sufficient ephemerides for 3rd order Bessel interpolation for a four-day period.

If the one-or two-block search and read operations are successful, control is regained at NORMAL and the tape is rewound without interrupt or interlock. At this time, SUN ephemerides for either 32 or 64 days are in core memory.

Besselian interpolation of right ascension is done by the INTERPOL subroutine and the interpolated result is converted to hours, minutes, and seconds and stored for type out. Declination and distance are then interpolated and stored for type out. The other quantities which are to be typed out by INTERCOM are set up. Control is transferred to INTERCOM 7 times for the seven line type out, which completes operation of the initialization section of SUNTRACK.

B. Working Section

The SUNTRACK working section begins at SUNCONT. Control is transferred to the subroutine DAYFIND which selects the day's ephemeris entry, stores the addresses of the table entries, and computes the interpolation argument P from the given value of CELTIME. The INTERPOL subroutine is then entered three times for the interpolation of right ascension, declination, radius and their time rates. An amount corresponding to the SUN's radius is subtracted from the interpolated value for accurate radar range

control. All values are converted, scaled and stored properly in core memory and control is transferred to the master control program.

C. Subroutines

The initialization section of the SUNTRACK program makes use of the INTERPOL, DAYFIND, STATUSCK, LEFRNDOFF, and ROUNDOFF subroutines. The working section uses all except STATUSCK.

1. INTERPOL

The SUNTRACK interpolation subroutine uses Bessel's interpolation formula (Reference 3) for 3rd difference interpolation of the ephemeris. The formula is

$$f_P = f_0 + P\delta f_{1/2} + \frac{P(P-1)}{4} [\delta^2 f_0 + \delta^2 f_1] \\ + \frac{P(P-1)(P-1/2)}{6} \delta^3 f_{1/2}$$

The quantities in the formula are associated with computer registers as follows:

- a. The address of f_0 is in index register 4.
- b. The interpolation argument P is in register P.
- c. $\delta f_{1/2}$ is in register GAMMA.
- d. $P(P-1)$ is in register PSQMP.
- e. $\delta^2 f_0 + \delta^2 f_1$ is in register DMINB.
- f. $\frac{P(P-1)}{6}$ is in register PSQMP6.
- g. $\delta^3 f_{1/2}$ is in register DMIN2CPLB.
- h. f_P is in the A register at the finish.

The subroutine also performs numerical differentiation using the following formula (Reference 3):

$$hf'_P = \delta f_{1/2} + \frac{2P-1}{4} [\delta^2 f_0 + \delta^2 f_1] \\ + \frac{3P^2 - 3P + 1/2}{6} \delta^3 f_{1/2}$$

At the completion of the subroutine, hf'_P is stored in the register NUMDERIV.

When the subroutine is entered, Index Register 4 contains the address of f_0 and the register SETINTAD contains the address of $\delta f_{1/2}$ of the quantity to be interpolated. Index register 3 is used to acquire the other two first difference registers.

2. DAYFIND

The DAYFIND subroutine computes the addresses of the ephemeris entries corresponding to the current day. It also computes the interpolation argument P by properly scaling the sum of CELTIME and DELTATEE. The value of P is always positive, even though time be set negative by the system control programs. The number in DAYINDEX, which can be -2, -1, 0, or +1, takes account of the effect of the integral part of CELTIME on the selection of ephemeris entry.

3. STATUSCK

The STATUSCK subroutine is entered from the external interrupt register associated with the tape channel when the interrupt occurs. Examination of the status code generates four possible outcomes:

- a. If the code indicates a normal completion (40), control is returned to the program at the interrupted point.
- b. If the code indicates that an end of tape mark was sensed, the tape is rewound and a message indicating failure to find the ephemeris is printed by the typewriter. The message is described in Section III B. Control is passed to the error return of the master control program.
- c. If the code indicates that an end of file mark was sensed, the register IMPERIAL is indexed and tested for the value 9. When less than 9, the next file is searched by passing control to TRYAGAIN. When IMPERIAL equals 9, an end of tape condition is assumed and the action is as described in (b) above.
- d. If the code indicates anything but end of file, end of tape, or normal completion, a tape error has occurred. The message described in Section III B, indicating the type of error is printed by the typewriter and control is passed to the error return of the master control program.

4. LEFRNDOFF

The LEFRNDOFF subroutine left shifts the AQ register the number of places indicated by the contents of index register 5 and rounds the A register.

5. ROUNDOFF

The ROUNDOFF subroutine right shifts the AQ register the number of places indicated by the contents of index register 5 and rounds the A register.

APPENDIX I

SPURT OUTPUT NO. 210

SUNTRACK

FRACHTMAN#7/14/64

CARDS	L1 ID	L2 LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*		SUNTRACK	PROGRAM FRACHTMAN#7/14/64					
00001	00001	SOLAR	EQUALS 100					
00002	00002	MANTITAPE	EQUALS 55					
00003	00003	TAPEINPUT	EQUALS 35					
00004	00004	EPHEM	MEANS C15*					
00005	00005	HENRY	U-TAG SUNCONT*SUNINIT	00000	00177	00002		
00006	00006		FD 1*SUNP;	00001	30322	32514		
00007	00007	SUNINIT	ENTRY	00002	61000	00000		
00008	00008		ENT A*W(IGNORE)	00003	11030	00766		
00009	00009		STR A*W(MONITAPE)	00004	15030	00055		
00010	00010		ENT A*W(INIERTUP)	00005	11030	00767		
00011	00011		STR A*W(TAPEINPUT)	00006	15030	00035		
00012	00012		ENT B4*877D	00007	12400	01555		
00013	00013		CL A*	00010	11000	00000		
00014	00014		STR A*W(YRREMAIN+B4)	00011	15034	01413	1ST TEMP STORAGE	
00015	00015	ERASE	B5*ERASE	00012	72400	00011		
00016	00016		ENT A*W(YEARMONTH)	00013	11020	63147		
00017	00017		SUB A*1961D	00014	21000	03651		
00018	00018		STR A*W(MONTHPRINT)	00015	15030	00746		
00019	00019		RSH AQ*30D	00016	03000	00036		
00020	00020		DIV 4	00017	23000	00004		
00021	00021		STR A*W(YRREMAIN)	00020	15030	01413	(0,1,2,3)	
00022	00022		MUL 1461D	00021	22000	02665		
00023	00023		STR Q*W(WHOLEYEAR)	00022	14030	01414		
00024	00024		ENT Q*W(YRREMAIN)	00023	10030	01413		
00025	00025		MUL 365D	00024	22000	00555		
00026	00026		RPL Y+Q*W(WHOLEYEAR)	00025	34030	01414		
00027	00027		RJP DAYFIND	00026	65000	00274		
00028	00028		ENT Q*W(TAPEBLOCK)	00027	10030	01417		
00029	00029		LSH Q*5	00028	05000	00005		
00030	00030		ADD Q*6	00029	26000	00006		
00031	00031		ADD Q*W(IDENT)	00030	26030	00771		
00032	00032		STR Q*W(SAFE)*SKIP	00033	14130	01430		
00033	00033		ENT Q*W(SAFE)	00034	10030	01430		
00034	00034		STR Q*W(TAPESEARCH)	00035	14030	01421		
00035	00035		ENT Q*29D	00036	10000	00035		
00036	00036		ENT A*1	00037	11000	00001		
00037	00037		C0M AQ*W(SLOTBLOCK)*YIN	00040	04430	01420		
00038	00038		JP NOTIN	00041	61000	00510		
00039	00039		IN EPHEM*W(EPHEMB)	00042	73670	00541		

SPURT OUTPUT NO. 210

SUNTRACK

FRACHTMAN#7/14/64

CARDS	L1	ID	LABEL	TA	STATEMENT	LUC	F	JKB	Y	NOTES
*	000050			NØ-JP	EPHEM*W(SRHIBIN)	00043	12000	00000		
*	000051			EX-FCT		00044	13670	00765		
*	000052			NØ-JP		00045	12000	00000		
*	000053			EX-FCT	EPHEM*W(TAPESEARCH)	00046	13670	01421		
*	000054			JP \$	EX-FCT EPHEM*W(REWINDNØ)	00047	61000	00047		
*	000055		NORMAL	ENT B4*L(RAAD)		00050	13670	00770		
*	000056			ENT A*L(RADIFAD)		00051	12410	01422		
*	000057			STR A*L(SETINTAD)		00052	11010	01425		
*	000058			RJP INTERPOL		00053	15010	01053		
*	000061			ENT Q*D*ANEG		00054	65000	01054		
*	000062			SUB A*W(TWØPIE)*APØS		00055	10700	00000		
*	000063			ADD A*W(TWØPIE)		00056	21630	01004		
*	000064			RSH AQ*27D		00057	20030	01004		
*	000065			DIV W(IHRAD)		00060	03000	00033		
*	000066			STR Q*W(RA2)		00061	23030	00773		
*	000067			CL Q*		00062	14030	00624		
*	000070			RSH AQ*23D		00063	10000	00000		
*	000071			DIV W(MINSRAD)		00064	03000	00027		
*	000072			STR Q*W(RA4)		00065	23030	00774		
*	000073			RSH AQ*30D		00066	14030	00627		
*	000074			MUL W(SRAD)		00067	03000	00036		
*	000075			LSH AQ*2*QØS		00070	22030	00772		
*	000076			ADD A*1		00071	07200	00002		
*	000077			STR A*W(RA6)		00072	20000	00001		
*	000100			ENT B4*L(DECAD)		00073	15030	00632		
*	000101			ENT A*L(DECDIFAD)		00074	12410	01423		
*	000102			STR A*L(SETINTAD)		00075	11010	01426		
*	000103			RJP INTERPOL		00076	15010	01053		
*	000104			STR A*W(GMI2)		00077	65000	01054		
*	000105			ENT Q*D*APØS		00100	15030	00712		
*	000106			CP A*		00101	10600	00000		
*	000107			RSH AQ*22D		00102	15040	00000		
*	000110			DIV W(MINSRAD)		00103	03000	00026		
*	000111			STR Q*W(DLN2)		00104	23030	00774		
*	000112			CL Q*		00105	14030	00657		
*	000113			RSH AQ*24D		00106	10000	00000		
*	000114			DIV W(SECSRAD)		00107	03000	00030		
*	000115			STR Q*W(DLN4)		00110	23030	01000		
*	000116			RSH AQ*30D		00111	14030	00662		
*	000117					00112	03000	00036		

SUNTRACK FRACHTMAN#7/14/64

CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*			MUL W(SARAD)	00113	22030	01001		
*	00121		LSH AQ*2*QPØS	00114	07200	00002		
*	00122		ADD A*1	00115	20000	00001		
*	00123		STR A*N(DLN6)	00116	15030	00665		
*	00124		ENT A*N(GMT2)*ANEQ	00117	11730	00712		
*	00125		JP \$+3	00120	61000	00123		
*	00126		ENT A*N(DLN2)	00121	11030	00657		
*	00127		STR A*CPW(DLN2)	00122	15070	00657		
*	00130		ENT A*N(CELTIME)	00123	11030	63133		
*	00131		ENT Q*Ø*APØS	00124	10600	00000		
*	00132		CP A*	00125	15040	00000		
*	00133		RSH AQ*26D	00126	03000	00032		
*	00134		DIV W(HDAY)	00127	23030	00775		
*	00135		STR Q*N(GMT2)	00130	14030	00712		
*	00136		CL Q*	00131	10000	00000		
*	00137		RSH AQ*23D	00132	03000	00027		
*	00140		DIV W(MDAY)	00133	23030	00776		
*	00141		STR Q*N(GMT4)	00134	14030	00715		
*	00142		RSH AQ*30D	00135	03000	00036		
*	00143		MUL W(SDAY)	00136	22030	00777		
*	00144		LSH AQ*2*QPØS	00137	07200	00002		
*	00145		ADD A*1	00140	20000	00001		
*	00146		STR A*N(GMT6)	00141	15030	00720		
*	00147		ENT A*N(CELTIME)*ANEQ	00142	11730	63133		
*	00150		JP \$+3	00143	61000	00146		
*	00151		ENT A*N(GMT2)	00144	11030	00712		
*	00152		STR A*CPW(GMT2)	00145	15070	00712		
*	00153		ENT B4*L(DISTAD)	00146	12410	01424		
*	00154		ENT A*L(DISTDIFAD)	00147	11010	01427		
*	00155		STR A*L(SEINTAD)	00150	15010	01053		
*	00156		RJP INTERPØL	00151	65000	01054		
*	00157		STR A*N(INITIAL18)	00152	15030	00733		
*	00160		ENT A*N(JULIANDAY)	00153	11030	01415		
*	00161		STR A*N(INITIAL3)	00154	15030	00570		
*	00162		ENT A*L(DAY)	00155	11010	63150		
*	00163		STR A*N(INITIAL12)	00156	15030	00601		
*	00164		RJP U(INTERCØM)	00157	65020	63426		
*	00165		U-TAG INITIALJD*Ø	00160	00560	00000		
*	00166		RJP U(INTERCØM)	00161	65020	63426		
*	00167		U-TAG RGHASC*Ø	00162	00602	00000		

SUNTRACK

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CARDS	L1 ID	LABEL	TA STATEMENT	LJC	F	JKB	Y	NOTES
*	00170		RJP U(INTERCØM)	00163	65020	63426		
*	00171		U-TAG DLN*Ø	00164	00635	00000		
*	00172		RJP U(INTERCØM)	00165	65020	63426		
*	00173		U-TAG INITIALDAT*Ø	00166	00571	00000		
*	00174		RJP U(INTERCØM)	00167	65020	63426		
*	00175		U-TAG GMT*Ø	00170	00670	00000		
*	00176		RJP U(INTERCØM)	00171	65020	63426		
*	00177		U-TAG INITIALDIS*Ø	00172	00723	00000		
*	00200		RJP U(INTERCØM)	00173	65020	63426		
*	00201	AIRPORT	U-TAG INITIALBØD*Ø	00174	00734	00000		
*	00202		RPL Y+1*L(SUNINIT)	00175	36010	00002		
*	00203		JP A	00176	61070	00000		
*	00204	SUNCØNT	ENTRY	00177	61000	00000		
*	00205		RPL Y+1*L(SUNCØNT)	00200	36010	00177		
*	00206		RJP DAYFIND	00201	65000	00274		
*	00207		ENT B4*L(RAAD)	00202	12410	01422		
*	00210		ENT A*L(RADIFAD)	00203	11010	01423		
*	00211		STR A*L(SETINTAD)	00204	15010	01053		
*	00212		RJP INTERPØL	00205	65000	01054		
*	00213		RSH AQ*3ØD	00206	03000	00036		
*	00214		MUL W(REVSRADIAN)	00207	22030	00764		
*	00215		JP MØUSE*QPØS	00210	60200	00212		
*	00216		ADD A*1	00211	20000	00001		
*	00217	MØUSE	STR A*W(RA)	00212	15030	63002		
*	00220		ENT Q*W(NUMDERIV)	00213	10030	01045		
*	00221		MUL W(DRSEC)	00214	22030	01003		
*	00222		ENT B5*4	00215	12500	00004		
*	00223		RJP RØUNDØFF	00216	65000	01403		
*	00224		STR A*W(RADØT)	00217	15030	63007	B37	RADS/SEC
*	00225		ENT B4*L(DECAD)	00220	12410	01423		
*	00226		ENT A*L(DECDFAD)	00221	11010	01426		
*	00227		STR A*L(SETINTAD)	00222	15010	01053		
*	00230		RJP INTERPØL	00223	65000	01054		
*	00231		RSH AQ*3ØD	00224	03000	00036		
*	00232		MUL W(REVSRADIAN)	00225	22030	00764		
*	00233		JP NEGDEC*ANEG	00226	60700	00505		
*	00234		JP BEAVER*QPØS	00227	60200	20231		
*	00235		ADD A*1	00230	20000	00001		
*	00236	BEAVER	STR A*W(DEC)	00231	15030	63003		
*	00237		ENT Q*W(NUMDERIV)	00232	10030	01045		

FRACHITMAN#7/14/64

SUNTRACK

CARDS	L1	ID	LABEL	TA	STATEMENT	LOC	F	J	K	S	Y	NOTES
	*			MUL	W(IRDRSECV)	00233	22030	01003				
	*			ENT	B5*4	00234	12500	00004				
	*			RJP	ROUNDOFF	00235	65000	01403				
	*			STR	A*W(DECDT)	00236	15030	63010	B37	RADS/SEC		
	*			ENT	B4*L(DISTAD)	00237	12410	01424				
	*			ENT	A*L(DISTDIFAD)	00240	11010	01427				
	*			STR	A*L(SETINTAD)	00241	15010	01053				
	*			RJP	INTERPØL	00242	65000	01054				
	*			RSH	AQ*4*QPOSS	00243	03200	00004				
	*			ADD	A*1	00244	20000	00001				
	*			SUB	A*W(SUNRAD)	00245	21030	01005				
	*			CP	A*	00246	15040	00000				
	*			STR	A*W(RADIUS)	00247	15030	63006				
	*			ENT	Q*W(NUMDERIV)	00250	10030	01045				
	*			MUL	W(AUDNMSEC)	00251	22030	01002				
	*			ENT	B5*7	00252	12500	00007	SUN			
	*			RJP	LEFRNDØFF	00253	65000	01373				
	*			STR	A*W(RADIUSDØT)	00254	15030	63011	B24	NM/SEC		
	*			EXIT		00255	61010	00177				
	*			CP	A*	00256	15040	00000				
	*			SUB	A*W(HALFDAY)*APØS	00257	21630	00763				
	*			JP	LESSØNE	00260	61000	00272				
	*			RSH	AQ*3ØD	00261	03000	00036				
	*			DIV	W(HALFDAY)	00262	23030	00763				
	*			LSH	AQ*3ØD	00263	07000	00036				
	*			SUB	A*1	00264	21000	00001				
	*			JP	TWØLESS*AZERO	00265	60400	00270				
	*			JP	TWØLESS*ANEG	00266	60700	00270				
	*			ENT	A*-3*SKIP	00267	11140	77774				
	*			ENT	A*-2	00270	11040	77775				
	*			JP	STØRE	00271	61000	00334				
	*			ENT	A*-1	00272	11040	77776				
	*			JP	STØRE	00273	61000	00334				
	*			ENTRY		00274	61000	00000				
	*			ENT	A*W(CELTIME)	00275	11030	63133				
	*			ADD	A*W(DELTATE)*APØS	00276	20630	63316				
	*			JP	NEGTIME	00277	61000	00311				
	*			LSH	A*L*APØS	00300	06600	00001				
	*			SUB	A*W(KEY)*SKIP	00301	21130	01017				
	*			STR	A*W(P)*SKIP	00302	15130	01026				
	*					00307						

SPURT OUTPUT NO. 210

SUNTRACK

FRÄCHTMAN#7/14/64

CARDS	LI ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	00310		STR A*W(P)*SKIP	00303	15130	01026		
*	00311		ENT A*Ø*SKIP	00304	11100	00000		
*	00312		ENT A*1	00305	11000	00001		
*	00313		JP TIMESLIDE	00306	61000	00317		
*	00314	DAYINDEX	Ø	00307	00000	00000		
*	00315	DAYINCREMENT	Ø	00310	00000	00000		
*	00316	NEGTIME	LSH A*1*APØS	02311	06600	00001		
*	00317		SUB A*W(KEY)*SKIP	00312	21130	01017		
*	00320		STR A*W(P)*SKIP	00313	15130	01026		
*	00321		STR A*W(P)*SKIP	00314	15130	01026		
*	00322		ENT A*-2*SKIP	00315	11140	77775		
*	00323		ENT A*-1	00316	11040	77776		
*	00324	TIMESLIDE	STR A*W(DAYINDEX)	00317	15030	00307		
*	00325		ENT A*W(CELTIME)*APØS	00320	11630	63133		
*	00326		JP FLATNEG	00321	61000	00256		
*	00327		SUB A*W(HALFDAY)*APØS	00322	21630	00763		
*	00328		LESSONE	00323	61000	00272		
*	00329		RSH AQ*	00324	03000	00000	300	
*	00330		DIV W(HALFDAY)	00325	23030	00763		
*	00331		LSH AQ*3ØD	00326	07000	00036		
*	00332		SUB A*1	00327	21000	00001		
*	00333		JP CERO*AZERØ	00330	60400	00333		
*	00334		JP CERO*ANEØ	00331	60700	00333		
*	00335		ENT A*1*SKIP	00332	11100	00001		
*	00336		ENT A*Ø	00333	11000	00000		
*	00337		JP CERO	00334	15030	00310		
*	00338		STR A*W(DAYINCRMT)	00335	20030	01414		
*	00339	STORE	ADD A*W(WHOLEYEAR)	00336	20030	03172	JD DEC 31 1960 GNWCH NØØN	
*	00340		ADD A*24373ØØD					
*	00344		ADD A*1(DAY)	00337	20010	63150		
*	00345		STR A*W(JULIANDAY)	00340	15030	01415		
*	00346		ADD A*W(DAYINDEX)	00341	20030	00307		
*	00347		A*2438151D	00342	21030	03173	JD MAY 1 1963 GNWCH NØØN	
*	00350		SUB A*W(DAYINCRMT)	00343	21030	00310		
*	00351		RSH AQ*3ØD	00344	03000	00036		
*	00352		DIV 3ØD	00345	23000	00440		
*	00353		Q*W(TAPEBLOCK)	00346	14030	01417		
*	00354		STR A*W(SLØTBLOCK)	00347	15030	01420		
*	00355		ENT Q*W(SLØTBLOCK)	00350	10030	01420		
*	00356		MUL 11	00351	22000	00011		

FRACHTMAN#7/14/64

CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	00357		ADD Q*AEPHEM+2)0D	00352	26000	02073		
*	00360		STR Q*L(RAAD)	00353	14010	01422		
*	00361		ADD Q*I	00354	26000	00001		
*	00362		STR Q*L(RADIFAD)	00355	14010	01425		
*	00363		ADD Q*I	00356	26000	00001		
*	00364		STR Q*L(DECAD)	00357	14010	01423		
*	00365		ADD Q*I	00360	26000	00001		
*	00366		STR Q*L(DECDIFAD)	00361	14010	01426		
*	00367		ADD Q*I	00362	26000	00001		
*	00370		STR Q*L(DISTAD)	00363	14010	01424		
*	00371		ADD Q*I	00364	26000	00001		
*	00372		STR Q*L(DISTDIFAD)	00365	14010	01427		
*	00373		EXIT	00366	61010	00274		
*	00374	STATUSCK	ENTRY	00367	61000	00000		
*	00375		STR EPHEM*W(TAPSTAT)	00370	17670	00502		
*	00376		ENT A*W(TAPSTAT)	00371	11020	00502		
*	00377		RSH A*11D	00372	02000	00013		
*	00400		STR A*W(TAPSTAT+1)	00373	15030	00503		
*	00401		RPL Y+1*L(STATUSCK)	00374	36010	00367		
*	00402		ENT B3*L(TAPSTAT+1)	00375	12310	00503		
*	00403		RIL	00376	60000	00000		
*	00404		JP STATACT+B3	00377	61003	00400		
*	00405	STATACT	JP BUST	00400	61000	00454		
*	00406		JP BUST	00401	61000	00454		
*	00407		JP BUST	00402	61000	00454		
*	00410		JP BUST	00403	61000	00454		
*	00411		JP BUST	00404	61000	00454	4 SEQ	ERR SYNC 20
*	00412		JP BUST	00405	61000	00454	5 REWINDING	24
*	00413		JP BUST	00406	61000	00454	6 CHAR COUNT	30
*	00414		JP BUST	00407	61000	00454	7 ILLEGAL	34
*	00415		EXIT	00410	61010	00367	10	40 NORMAL
*	00416		JP BUST	00411	61000	00454	11	REPEAT 44
*	00417		JP BUST	00412	61000	00454	12	SEQ ERR COUNT 50
*	00420		JP ENDFILE	00413	61000	00450	13	E0F 54
*	00421		JP CANTFIND	00414	61000	00420	14	EOF 60
*	00422		JP BUST	00415	61000	00454	15	NONSUCH
*	00423		JP BUST	00416	61000	00454	16	ABN F C 70
*	00424	CANTFIND	JP BUST	00417	61000	00454	17	INTERLOCK 74
*	00425	EX-FCT	EPHEM*W(REWINDNO)	00420	13670	00770		
*	00426	ENT B4*L(MONTHPRINT)		00421	12410	00746		

SUNTRACK

FRACTION #7/14/64

LDC + JKBY
CARDS L1 ID LABEL TA STATEMENT
NOTES

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ENT A*(W(YEARPRINT+B4))
STR A*(W(NODATA2))
ENT B4*L(YEARMONTH)
ENT A*(W(MONTHPRINT+B4))
RPL A+Y*(W(NODATA2))
CL A*
ENT Q*L(BARRIER)
DIV 12
ADD A*60
STR A*(UIMPERIAL)
CL A*
DIV 12
JP ALBERT*ALERO
ADD A*60
LSH A*6
ADD A*(UIMPERIAL)
ADD A*(UIMPERIAL)
LSH A*6
ADD A*3105000005
STR A*(W(NODATA3))
RJP U(INTERCOM)
U-TAG NODATA#1
JP L(SUNINIT)
RPL Y+L(UIMPERIAL)
SUB A*11
JP CANTFIND*ALERD
JP TRYAGAIN
EX-FACT EPHEM*W(R-EWINDW)
ENT A*L(TAPSTAT+1)
JP A*1
RSH A*1
ADD A*60
LSH A*6
STR A*L(TAPSTAT+2)
ENT A*L(TAPSTAT+1)
SEL CL*X77776
LSH A*2
ADD A*60
ADD A*L(TAPSTAT+2)
STR A*L(TAPSTAT+3)
RJP U(TAPEBUSTL+3)
U-TAG

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SUNTRACK

FRACHTMAN*1/14/64

CARDS	LI ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	00417		JP L(SJNINIT)		00412	61010	00002	
*	00500	TAPEBJST	FD J*A		00473	06050	50505	
*	00511		-0 TAPEBUSTI		00474	77777	00475	
*	00502	TAPEBUSTI	FD J*IIIC		00475	16161	01005	
*	00503		FD J*STATU		00476	30310	63132	
*	00504		FD 2*S SI		00477	30050	53061	
*	00505		-0 -0		00500	05050	50500	
*	00506	TAPSTAT	+0 +0		00501	77777	77777	
*	00507		+0		00502	00000	00000	
*	00510		JP BEAVER*QNEG		00503	00000	00000	
*	00511	VEGDE	JP SUB A*1		00504	00000	00000	
*	00512		JP BEAVER		00505	60300	00231	
*	00513		ADD A*1		00506	00000	00001	
*	00514	NOTIN	JP SUB A*W(SL0TBLCK)		00507	61000	00231	
*	00515		JP BLOCKAY*AP0S		00510	20000	00001	
*	00516		IN EPHEM*W(EPHEM)		00511	21030	01420	
*	00517	BLOCKSEE	NO-0P EX-FCT EPHEM*W(SRHIBIN)		00512	00600	00530	
*	00520		NO-0P EX-FCT EPHEM*W(SRHIBIN)		00513	13670	00541	
*	00521		NO-0P EX-FCT EPHEM*W(TAPESEARCH)		00514	12000	00000	
*	00522		EX-FCT EPHEM*W(TAPESEARCH)		00515	13670	00765	
*	00523		EX-FCT EPHEM*W(TAPESEARCH)		00516	12000	00000	
*	00524		JP \$ IN EPHEM*W(EPHEM)		00517	13670	01421	
*	00525		ENT A*40 EX-FCT EPHEM*W(SRHIBIN)		00520	61000	00520	
*	00526	PATCH	RPL A+Y*W(TAPESEARCH)		00521	73670	00542	
*	00527		EX-FCT EPHEM*W(TAPESEARCH)		00522	11000	00040	
*	00530		RPL A+Y*W(TAPESEARCH)		00523	13670	00765	
*	00531		EX-FCT EPHEM*W(TAPESEARCH)		00524	24030	01421	
*	00532		JP \$		00525	13670	01421	
*	00533		JP NORMAL IN EPHEM*W(EPHEM)		00526	61000	00526	
*	00534	BLOCKAY	ENT A*-40 EX-FCT EPHEM*W(SRHIBIN)		00527	61000	00050	
*	00535		RPL A+Y*W(TAPESEARCH)		00530	73670	00540	
*	00536		EX-FCT EPHEM*W(TAPESEARCH)		00531	11040	77737	
*	00537		EX-FCT EPHEM*W(TAPESEARCH)		00532	13670	00765	
*	00540		EX-FCT EPHEM*W(TAPESEARCH)		00533	24030	01421	
*	00541		JP \$ IN EPHEM*W(EPHEM)		00534	13670	01421	
*	00542		JP PATCH		00535	61000	00535	
*	00543	EPHEMA	U-TAG AEPHEM+287D*AEPHEM		00536	73670	00541	
*	00544	EPHEMB	U-TAG AEPHEM+575D*AEPHEM+288D		00537	61000	00522	
*	00545	EPHEMB	U-TAG		00540	12070	01431	
					00541	02530	02071	

SUNTRACK FRACTHTMAN*7/14/64

CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
-	00546	EPHEM	U-TAG AEPHEM+863D*AEPHEM+576D	00542	03170	02531		
-	00547	N0DATA	FD Ø*A -Ø N0DATA1	00543	06050	50505		
-	00550		FD Ø*SUN E	00544	77777	00545		
-	00551	N0DATA1	FD Ø*PHEME	00545	30322	30512		
-	00552		FD Ø*RIS F	00546	25151	22212		
-	00553		FD Ø*ØR	00547	27163	00513		
-	00554		FD Ø*63/63	00550	24270	50505		
-	00555	N0DATA2	FD Ø*ØT	00551	66637	46663		
-	00556		FD Ø*AMØNG	00552	05232	43105		
-	00557		FD Ø*FIRS	00553	06222	42314		
-	00560		FD Ø*T	00554	05131	62730		
-	00561	N0DATA3	FD Ø*FILES	00555	31050	50505		
-	00562		-Ø	00556	13162	11230		
-	00563		FD Ø*A	00557	77777	77777		
-	00564	INITIALJD	U-TAG INITIAL2*INITIAL1	00560	06050	50505		
-	00565		FD Ø*JULIA	00561	00566	00562		
-	00566	INITIAL1	FD 2*N DAY	00562	17322	11606		
-	00567			00563	23051	10636		
-	00570		-Ø	00564	05050	50505		
-	00571	INITIAL2	FD Ø*D	00565	77777	77777		
-	00572		-Ø INITIAL3	00566	11050	50505		
-	00573	INITIAL3	Ø	00567	77777	00570		
-	00574	INITIALDAT	FD Ø*A	00570	00000	00000		
-	00575		U-TAG INITIAL11*INITIAL10	00571	06050	50505		
-	00576	INITIAL10	FD 3*DAY ØF YEAR	00572	00577	00573		
-				00573	11063	60524		
-				00574	13053	61206		
-				00575	27050	50505		
-				00576	77777	77777		
-				00577	11050	50505		
-				00600	77777	00601		
-				00601	00000	00000		
-				00602	06050	50505		
-				00603	00000	00620		
-				00604	11050	50505		
-				00605	00000	00624		
-				00606	06050	50505		
-				00607	00000	00625		
-				00610	11050	50505		
-				00611	00000	00627		
-				00612	00000	00627		

SUNTRACK FRACTION#7/14/64

CARDS	LI	ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*		00613		FD 0*A	00612	06012	06012		
*		00614		FD RA5	00613	00000	00000		
*		00615		FD 0*X2B23	00614	35620	35620		
*		00616		FD RA6	00615	00000	00000		
*		00617		FD 0*A	00616	06050	06050		
*		00620		FD -D RA7	00617	77777	00633		
*		00621	RA1	FD 3*RIGHT ASC	00620	27161	41531		
*		00622		-D	00621	05063	01005		
*		00623	RA2	FD	00622	05050	05050		
*		00624	RA3	FD 1505	00623	77777	77777		
*		00625		-D	00624	00000	00000		
*		00626	RA4	FD	00625	00000	01505		
*		00627	RA5	FD 2205	00626	77777	77777		
*		00628		-D	00627	00000	00000		
*		00629	RA6	FD	00628	00000	02205		
*		00630		0	00629	77777	77777		
*		00631	RA7	FD	00630	00000	00000		
*		00632		3D	00631	00000	00000		
*		00633		-D	00632	00000	00000		
*		00634	DLN	FD 0*A	00633	06050	50505		
*		00635		FD 0*D	00634	00000	00653		
*		00636		FD 0*D	00635	00000	00653		
*		00637		FD DLN1	00636	00000	00653		
*		00640		FD 0*A	00637	11050	50505		
*		00641		FD DLN2	00638	00000	00657		
*		00642		FD 0*D	00639	06050	50505		
*		00643		FD 0*D	00640	00000	00657		
*		00644		FD 0*A	00641	06050	50505		
*		00645		FD DLN3	00642	00000	00660		
*		00646		FD 0*D	00643	11050	50505		
*		00647		FD DLN4	00644	00000	00662		
*		00650		FD 0*A	00645	06050	50505		
*		00651		FD DLN5	00646	00000	00663		
*		00652		FD 0*X2B23	00647	35620	76263		
*		00653		-D	00648	00000	00665		
*		00654	DLN2	FD 0*A	00649	06050	50505		
*		00655	DLN3	FD DLN6	00650	00000	00666		
*		00656		-D	00651	06050	50505		
*		00657		DLN7	00652	77777	00666		
*		00658		3*DECLINATION	00653	11121	02116		
*		00659		FD	00654	23063	11624		
*		00660		-D	00655	23050	50505		
*		00661		0	00656	77777	77777		
*		00662		1105	00657	00000	00000		
*		00663		-D	00660	00000	01105		
*		00664			00661	77777	77777		

SPURT OUTPUT VU. 212

SUNTRACK

FRACHTMAN#7/14/64

CARDS	L1 ID	ID LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
• • •	00657	DLN4	Ø	00662	00000	00000	00000	
• • •	00660	DLN5	72Ø5	00663	00000	00000	07205	
• • •	00661		-Ø	00664	77777	77777	77777	
• • •	00662	DLN6	Ø	00665	00000	00000	00000	
• • •	00663	DLN7	52	00666	00000	00000	00052	
• • •	00664		-Ø	00667	77777	77777	77777	
• • •	00665	GMT	FD	00670	06050	50505		
• • •	00666		Ø*A	00671	00000	00000	00706	
• • •	00667		FD	00672	11050	50505		
• • •	00670		Ø*D	00673	00000	00000	00712	
• • •	00671		GMT2	00674	06050	50505		
• • •	00672		FD	00675	00000	00000	00713	
• • •	00673		Ø*A	00676	11050	50505		
• • •	00674		GMT4	00677	00000	00000	00715	
• • •	00675		FD	00700	06050	50505		
• • •	00676		Ø*A	00701	00000	00000	00716	
• • •	00677		FD	00702	35620	76263		
• • •	00700		Ø*D	00703	00000	00000	00715	
• • •	00701		GMT6	00704	06050	50505		
• • •	00702		FD	00705	77777	00721		
• • •	00703	GMT1	Ø*A	00706	32231	63312		
• • •	00704		GMT7	00707	27300	62105		
• • •	00705		3*UNIVERSAL TIME	00710	31162	21205		
• • •	00706	GMT2	FD	00711	77777	77777		
• • •	00707	15Ø5		00712	00000	00000	01505	
• • •	00710	GMT4	-Ø	00713	00000	00000	01505	
• • •	00711	GMT5	Ø	00714	77777	77777		
• • •	00712	22Ø5	-Ø	00715	00000	00000	00000	
• • •	00713	GMT6	Ø	00716	00000	02205		
• • •	00714	GMT7	3Ø	00717	77777	77777		
• • •	00715		-Ø	00720	00000	00000	00000	
• • •	00716	INITIALDIS	FD	00721	00000	00030		
• • •	00717	INITIAL	Ø*A	00723	06050	50505		
• • •	00720	INITIAL16	U-TAG	00724	00731	00725		
• • •	00721		Ø*DISTA	00725	11163	03106		
• • •	00722		Ø*NCE	00726	23101	20505		
• • •	00723		FD	00727	06053	20505		
• • •	00724	INITIAL17	Ø*A U	00730	77777	77777		
• • •			-Ø	00731	35700	76270		

SUNTRACK

FRACHIMAN#7/14/64

CARDS	L1	ID	LABEL	TA	STATEMENT	LOC	F	J	K	Y	NOTES
*	00725		INITIAL18	-J	INITIAL18	00732	77777	00733			
*	00726		INITIAL18	J		00733	00000	00000			
*	00727		INITIALBD	FD	0*A	00734	06050	50505			
*	00730		U-TAG	U-TAG	INITIAL20*INITIAL19	00735	00742	00736			
*	00731		INITIAL19	FD	3*OBJECT	00736	24071	71210			
*	00732			-J		00737	31050	50505			
*	00733		INITIAL20	FD	0*A	00740	05050	50505			
*	00734			-J	INITIAL21	00741	77777	77777			
*	00735		INITIAL21	3032230000		00742	06050	50505			
*	00736			-J		00743	77777	00744			
*	00737		M0NTHPRINT	0		00744	30322	30000	FD	J	SUN
*	00740			0061000000		00745	77777	77777			
*	00741			0062000000		00750	00620	00000			
*	00742			0063000000		00751	00630	00000			
*	00743			0064000000		00752	00640	00000			
*	00744			0065000000		00753	00650	00000			
*	00745			0066000000		00754	00660	00000			
*	00746			0067000000		00755	00670	00000			
*	00747			0070000000		00756	00700	00000			
*	00750			0071000000		00757	00710	00000			
*	00751			6160000000		00760	61600	00000			
*	00752			6161000000		00761	61610	00000			
*	00753			6162000000		00762	61620	00000			
*	00754		HALFDAY	1000000000		00763	10000	00000			
*	00755		REVSRADIAN	2427630154		00764	24276	30154	DEC		
*	00756		SRHIBIN	5600000002		00765	56000	00002			
*	00757		IGNORE	6000000000		00766	60000	00000			
*	00760		INTERRUPT	RJP STATUSCK		00767	65000	00367			
*	00761		REWINDN0	201000002		00770	20100	00002	1	B	NO INT
*	00762		IDENT	0001200000		00771	00012	00000	SUN		
*	00763		SRAD	3266677126		00772	32666	77126	DEC		13750.987815 43
*	00764		HRAD	1030124435		00773	10301	24435	DEC	/12	26179939B29 PI
*	00765		MINSRAD	2167643241		00774	21676	43241	DEC	8PI/120	55850536B29 12
*	00766		HDAY	1252525250		00775	12525	25250	DEC		33333333B29 8/

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	J	K	B	Y	NOTES
*	00767	MDAY	2660266026					24	B32	* 71111111B29
*	00770	SDAY	2506000000					DEC	10/1440	2E
*	00771	SECSRAD	2304045527	00776	26602	66026				
*	00772	SARAD	3113343172	00777	25060	00000				
*	00773	AUDNMSEC	3515643656	01000	23040	45527				
*	00774	RDRSEC	3021344241	01001	31133	43172				
*	00775	TWOPIE	3110375523	01002	35156	43656				
*	00776	SUNRAD	0000230432	01003	30213	44241				
*	00777	YEARPRINT	0000746661	01004	31103	75523				
*			0000746662	01005	00002	30432				
*			0000746663	01006	00007	46661				
*			0000746664	01007	00007	46662				
*			0000746665	01008	00010	46663				
*			0000746666	01009	00007	46664				
*			0000746667	01010	00007	46665				
*			0000746670	01011	00007	46666				
*			0000746671	01012	00007	46665				
*			4000000000	01013	00007	46666				
*			0000746672	01014	00007	46667				
*			0000746673	01015	00007	46670				
*			0000746674	01016	00007	46671				
*			0000746675	01017	40000	00000				
*			0000746676	01018	00000	00000				
*			0000746677	01019	00000	00000				
*			0000746678	01020	00000	00000				
*			0000746679	01021	00000	00000				
*			0000746680	01022	00000	00000				
*			0000746681	01023	00000	00000				
*			0000746682	01024	00000	00000				
*			0000746683	01025	00000	00000				
*			0000746684	01026	00000	00000				
*			0000746685	01027	20000	00000				
*			0000746686	01030	00000	00000				
*			0000746687	01031	00000	00000				
*			0000746688	01032	00000	00000				
*			0000746689	01033	00000	00000				
*			0000746690	01034	00000	00000				

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CARDS	L1	I1	LABEL	TA STATEMENT	LUC	F	JKB	Y	NOTES
	01026	*		0	01035	00000	00000		
	01027	*		0	01036	00000	00000		
	01030	*		0	01037	00000	00000		
	01031	PSQMP		0	01040	00000	00000		
	01032	PSQMP6		0	01041	00000	00000		
	01033	THIRD		1252525252	01042	12525	25252		
	01034	SIXTH		0525252525	01043	05252	52525		
	01035	KENNEDY		0	01044	00000	00000		
	01036	NUMBERIV		0	01045	00000	00000		
	01037	F3ESSEL		0	01046	00000	00000		
	01040	*		0	01047	00000	00000		
	01041	*		0	01050	00000	00000		
	01042	*		0	01051	00000	00000		
	01043	*		0	01052	00000	00000		
	01044	SETINTAD		0	01053	00000	00000		
	01045	INTERPOL		ENTRY Q*-11	01054	61000	00000		
	01046	*		RPL Y+Q*L(SETINTAD)	01055	10040	77766		
	01050	*		ENT B3*L(SETINTAD)	01056	34010	01053		
	01051	*		CL Q*	01057	12310	01053		
	01052	*		ENT A*W(B+B3)	01060	10000	00000		
	01053	*		STR A*W(BETA)	01061	11033	00000		
	01054	*		ENT B3*11+B3	01062	15030	01021		
	01055	*		ENT A*W(B+B3)	01063	12303	00011		
	01056	*		STR A*W(GAMMA)	01064	11033	00000		
	01057	*		ENT B3*11+B3	01065	15030	01022		
	01060	*		ENT A*W(B+B3)	01066	12303	00011		
	01061	*		STR A*W(DELTA)	01067	11033	00000		
	01062	*		ENT A*W(DELTA)	01070	15030	01023		
	01063	*		SUB A*W(BETA)	01071	11030	01023		
	01064	*		STR A*W(DMINB)	01072	21030	01024		
	01065	*		ADD A*W(DMINB)	01073	15030	01030		
	01066	*		STR A*W(BESSEL)	01074	20030	01030		
	01067	*		ENT A*W(DELTA)	01075	15030	01033		
	01070	*		ADD A*W(BETA)	01076	11030	01023		
	01071	*		SUB A*W(GAMMA)	01077	15030	01021		
	01072	*		SUB A*W(GAMMA)	01078	21030	01022		
	01073	*		STR A*W(DMIN2CPLB)	01079	15030	01031		
	01074	*		JP DIFF4ZERD*UPUS	01103	60200	01255		
	01075	*		ENT A*W(EPSILON)	01104	11030	01024		

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	011076		SUB A*W(FIRSTDIF)	01105	21030	01020		
*	011077		SUB A*W(BESSEL)	01106	21030	01033		
*	011080		STR A*W(EP2BM2DMA)	01107	15030	01032		
*	011081	PARTIAL	ENT Q*W(P)	01108	10030	01026		
*	011082		MUL W(GAMMA)	01111	22030	01022		
*	011083		LSH AQ*1	01112	07000	00001		
*	011084		STR A*W(BESSEL+1)	01113	15030	01034		
*	011085		STR A*W(BESSEL)*AP0\$	01114	15630	01033		
*	011086		JP NEGBESSI	01115	61000	01357		
*	011087		LSH AQ*29D	01116	07000	00035		
*	01110		SEL CL*W(KEY)	01117	52030	01017		
*	01111	ST0R1	STR A*W(FBESSEL)	01118	15030	01046		
*	01112		STR A*W(FBESSEL+1)	01119	15030	01047		
*	01113		ENT Q*W(P)	01121	15030	01026		
*	01114		MUL W(P)	01122	10030	00001		
*	01115		ENT B5*1	01123	22030	01026		
*	01116		RJP LEFRND0FF	01124	12500	00001		
*	01117		SUB A*W(P)	01125	65000	01373		
*	01120		STR A*W(PSQMP)	01126	21030	01026		
*	01121		RSH AQ*30D	01127	15030	01040		
*	01122		MUL W(DMINB)	01130	03000	00036		
*	01123		RSH AQ*1	01131	22030	01030		
*	01124		STR A*W(BESSEL+2)*AP0\$	01132	03000	00001		
*	01125		JP NEGBESS2	01133	15630	01035		
*	01126		LSH AQ*29D	01134	61000	01362		
*	01127		SEL CL*W(KEY)	01135	07000	00035		
*	01130	ST0R2	STR A*W(FBESSEL+2)	01136	52030	01017		
*	01131		ENT A*W(PSQMP)	01137	15030	01050		
*	01132		RSH AQ*30D	01140	11030	01040		
*	01133		DIV 6*AZERO	01141	03000	00036		
*	01134		JP REMAINDER	01142	23400	00006		
*	01135	LINC0LN	STR Q*W(PSQMP6)	01143	61000	01257		
*	01136		ENT Q*W(P)	01144	14030	01041		
*	01137		SUB Q*W(HALF)	01145	10030	01026		
*	01140		MUL W(PSQMP6)	01146	27030	01027		
*	01141		RJP LEFRND0FF	01147	22030	01041		
*	01142		RSH AQ*30D	01150	65000	01373		
*	01143		MUL W(DMIN2CPLB)	01151	03000	00036		
*	01144		LSH AQ*1	01152	22030	01031		
*	01145		STR A*W(BESSEL+3)*AP0\$	01153	07000	00001		
*				01154	15630	01036		

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	01146		JP NEGNESS3	01155	61000	01365		
*	01147		LSH AQ*29D	01156	07000	00035		
*	01154	ST0R3	SEL CL*W(KEY)	01157	52030	01017		
*	01151		STR A*W(FBESSEL+3)	01160	15030	01051		
*	01152		ENT A*(EP2BM2UMA)*AN0T	01161	11530	01032		
*	01153		JP NDFDURTH	01162	61000	01252		
*	01154		ENT Q*W(PSQMP6)	01163	10030	01041		
*	01155		SUB Q*W(THIRD)	01164	27030	01042		
*	01156		MUL W(PSQMP)	01165	22030	01040		
*	01157		RUP LEFRND0FF	01166	65000	01373		
*	01160		RSH AQ*30D	01167	03000	00036		
*	01161		MUL W(EP2BM2DMA)	01170	22030	01032		
*	01162		RSH AQ*2	01171	03000	00002		
*	01163		STR A*W(BESSEL+4)*AP0S	01172	15630	01037		
*	01164		JP NEGNESS4	01173	61000	01370		
*	01165		LSH AQ*29D	01174	07000	00035		
*	01166		SEL CL*W(FBESSEL)	01175	52030	01017		
*	01167	ST0R4	STR A*W(FBESSEL+4)	01176	15030	01052		
*	01170		ENT A*W(FBESSEL)	01177	11030	01046		
*	01171		SEL CP*W(FBESSEL+2)	01200	51030	01050		
*	01172		JP FLØTEST1*APØS	01201	60600	01271		
*	01173	NØFLØ1	ENT Q*W(BESSEL+2)	01202	10030	01035		
*	01174	FIX1	RPL Y+Q*W(BESSEL)	01203	34030	01033		
*	01175		ENT A*W(FBESSEL+2)	01204	11030	01050		
*	01176		RPL A+Y*W(FBESSEL)	01205	24030	01046		
*	01177		SEL CP*W(FBESSEL+3)	01206	51030	01051		
*	01200		JP FLØTEST2*APØS	01207	60600	01313		
*	01201	NØFLØ2	ENT Q*W(BESSEL+3)	01210	10030	01036		
*	01202	FIX2	RPL Y+Q*W(BESSEL)	01211	34030	01033		
*	01203		ENT A*W(FBESSEL+3)	01212	11030	01051		
*	01204		RPL A+Y*W(FBESSEL)	01213	24030	01046		
*	01205		SEL CP*W(FBESSEL+4)	01214	51030	01052		
*	01206		JP FLØTEST3*APØS	01215	60600	01335		
*	01207	NØFLØ3	ENT Q*W(BESSEL+4)	01216	10030	01037		
*	01210	FIX3	RPL Y+Q*W(BESSEL)	01217	34030	01033		
*	01211		ENT A*W(FBESSEL+4)	01220	11030	01052		
*	01212		RPL A+Y*W(FBESSEL)	01221	24030	01046		
*	01213		ENT Q*W(P)	01222	10030	01026		
*	01214		SUB Q*W(HALF)	01223	27030	01027		
*	01215		MUL W(DMINB)	01224	22030	01030		

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	01216		B5*	01225	12500	00000		
*	01217		RJP LEFRNDØFF	01226	65000	01373		
*	01220		STR A*W(KENNEDY)	01227	15030	01044		
*	01221		ENT Q*W(PSQMP)	01230	10030	01040		
*	01222		ADD Q*W(SIXTH)	01231	26030	01043		
*	01223		MUL W(DMIN2CP LB)	01232	22030	01031		
*	01224		RJP LEFRNDØFF	01233	65000	01373		
*	01225		ADD A*W(KENNEDY)	01234	20030	01044		
*	01226		ADD A*W(GAMMA)	01235	20030	01022		
*	01227		STR A*W(NUMDERIV)	01236	15030	01045		
*	01230		ENT A*W(FBESSEL)*APØS	01237	11630	01046		
*	01231		JP MINUS	01240	61000	01246		
*	01232		LSH A*1*ANEG	01241	66700	00001		
*	01233		ENT A*W(BESSEL)*SKIP	01242	11130	01033		
*	01234		RPL Y+1*W(BESSEL)	01243	36030	01033		
*	01235	SUM	ADD A*W(Ø+B4)	01244	20034	00000		
*	01236		EXIT	01245	61010	01054		
*	01237	MINUS	LSH A*1*APØS	01246	66600	00001		
*	01240		ENT A*W(BESSEL)*SKIP	01247	11130	01033		
*	01241		RPL Y-1*W(BESSEL)	01250	37030	01033		
*	01242		JP SUM	01251	61000	01244		
*	01243	NØFØURTH	CL A*	01252	11000	00000		
*	01244		STR A*W(BESSEL+4)	01253	15030	01037		
*	01245		JP STØR4	01254	61000	01176		
*	01246	DIFF4ZERO	STR Q*W(EP2BM2DMA)	01255	14030	01032		
*	01247		JP PARTIAL	01256	61000	01110		
*	01250	REMAINDER	JP CIVIL*QPØS	01257	60200	01265		
*	01251		STR A*A	01260	15040	00000		
*	01252		SUB A*3*APØS	01261	21600	00003		
*	01253		JP LINCØLN	01262	61000	01144		
*	01254		SUB Q*1	01263	27000	00001		
*	01255		JP LINCØLN	01264	61000	01144		
*	01256	CIVIL	SUB A*3*APØS	01265	21600	00003		
*	01257		JP LINCØLN	01266	61000	01144		
*	01260		ADD Q*1	01267	26000	00001		
*	01261		JP LINCØLN	01270	61000	01144		
*	01262	FLØTEST1	ENT A*W(FBESSEL)*ANE ^G	01271	11730	01046		
*	01263		ADD A*W(FBESSEL+2)*SKIP	01272	20130	01050		
*	01264		JP BØTHNEG ^I	01273	61000	01303		
*	01265		JP NØFLØ1*APØS	01274	60600	01202		

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	J	K	B	Y	NOTES
*	J1266		SEL CL*W(KEY)	01275	52030	01017				
*	01267		STR A*W(FBESSEL)	01276	15030	01046				
*	01270		ENT Q*W(BESSEL+2)	01277	10030	01035				
*	01271		ADD Q*1	01300	26000	00001				
*	01272		RPL Y+Q*W(BESSEL)	01301	34030	01033				
*	01273	BOTHNEG1	JP FIX1+3	01302	61000	01206				
*	01274	BOTHNEG1	ADD A*W(FBESSEL+2)	01303	20030	01050				
*	01275		JP NØFLØ1*ANEG	01304	60700	01202				
*	01276		SEL SET*W(KEY)	01305	50030	01017				
*	01277		STR A*W(FBESSEL)	01306	15030	01046				
*	01300		ENT Q*W(BESSEL+2)	01307	10030	01035				
*	01301		SUB Q*1	01310	27000	20001				
*	01302		RPL Y+Q*W(BESSEL)	01311	34030	01033				
*	01303		JP FIX1+3	01312	61000	01206				
*	01304	FLØTEST2	ENT A*W(FBESSEL)*ANEG	01313	11730	01046				
*	01305		ADD A*W(FBESSEL+3)*SKIP	01314	20130	01051				
*	01306		JP BOTHNEG2	01315	61000	01325				
*	01307		JP NØFLØ2*APØS	01316	60600	01210				
*	01310		SEL CL*W(KEY)	01317	52030	01017				
*	01311		STR A*W(FBESSEL)	01320	15030	01046				
*	01312		ENT Q*W(BESSEL+3)	01321	10030	01036				
*	01313		ADD Q*1	01322	26000	00001				
*	01314		RPL Y+Q*W(BESSEL)	01323	34030	01033				
*	01315		JP FIX2+3	01324	61000	01214				
*	01316	BOTHNEG1	ADD A*W(FBESSEL+3)	01325	20030	01051				
*	01317		JP NØFLØ2*ANEG	01326	60700	01210				
*	01320		SEL SET*W(KEY)	01327	50030	01017				
*	01321		STR A*W(FBESSEL)	01330	15030	01046				
*	01322		ENT Q*W(BESSEL+3)	01331	10030	01036				
*	01323		SUB Q*1	01332	27000	00001				
*	01324		RPL Y+Q*W(BESSEL)	01333	34030	01033				
*	01325		JP FIX2+3	01334	61000	01214				
*	01326	FLØTEST3	ENT A*W(FBESSEL)*ANEG	01335	11730	01046				
*	01327		ADD A*W(FBESSEL+4)*SKIP	01336	20130	01052				
*	01330		JP BOTHNEG3	01337	61000	01347				
*	01331		JP NØFLØ3*APØS	01340	60600	01216				
*	01332		SEL CL*W(KEY)	01341	52030	01017				
*	01333		STR A*W(FBESSEL)	01342	15030	01046				
*	01334		ENT Q*W(BESSEL+4)	01343	10030	01037				
*	01335		ADD Q*1	01344	26000	00001				

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	J	K	B	Y	NOTES
*	01336		RPL Y+Q*W(BESSEL)	01345	34030	01033				
*	01337	BOTHNEG3	JP FIX3+3	01346	61000	01222				
*	01340		ADD A*M(FBESSEL+4)	01347	20030	01052				
*	01341		JP NFL03*ANEG	01350	60700	01216				
*	01342		SEL SET*WIKEY)	01351	50030	01217				
*	01343		STR A*M(FBESSEL)	01352	15030	01046				
*	01344		ENT Q*W(BESSEL+4)	01353	12030	01037				
*	01345		SUB Q*1	01354	27000	00001				
*	01346		RPL Y+Q*W(BESSEL)	01355	34030	01033				
*	01347		JP FIX3+3	01356	61000	01222				
*	01350	NEGBESS1	LSH AQ*29D	01357	07000	00035				
*	01351		SEL SET*W(KEY)	01360	50030	01017				
*	01352	NEGBESS2	JP ST0R1	01361	61000	01120				
*	01353		LSH AQ*29D	01362	07000	00035				
*	01354		SEL SET*W(KEY)	01363	50030	01017				
*	01355		JP ST0R2	01364	61000	01137				
*	01356	NEGBESS3	LSH AQ*29D	01365	07000	00035				
*	01357		SEL SET*W(KEY)	01366	50030	01017				
*	01360		JP ST0R3	01367	61000	01160				
*	01361	NEGBESS4	LSH AQ*29D	01368	07000	00035				
*	01362		SEL SET*W(KEY)	01369	50030	01017				
*	01363	LEFRND0FF	JP ST0R4	01370	61000	01176				
*	01364		ENTRY MIKE*ANEG	01373	61000	00000				ENTER WITH B5 SET TO SHIFTS
*	01365		JP AQ*B5*QP0S	01374	60700	01400				
*	01366		ADD A*1	01375	07205	00000				
*	01367		01376	01376	20000	00001				
*	01370	MIKE	EXIT	01377	61010	01373				
*	01371		LSH AQ*B5*QNEG	01378	07305	00000				
*	01372		SUB A*1	01379	21000	00001				
*	01373	ROUND0FF	EXIT	01380	61010	01373				
*	01374		ENTRY MAX*ANEG	01383	61000	00000				ENTER WITH B5 SET TO SHIFTS
*	01375		JP AQ*B5*QP0S	01384	60700	01410				
*	01376		ADD A*1	01385	03205	00000				
*	01377		01378	01386	20000	00001				
*	01400		EXIT	01387	61010	01403				
*	01401	MAX	RSW AQ*B5*QNEG	01388	03305	00000				
*	01402		SUB A*1	01389	21000	00001				
*	01403		EXIT	01412	61010	01403				
*	01404	YRREMAIN	0	01413	00000	00000				
*	01405	WHOLEYEAR	0	01414	00000	00000				

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CARDS	L1 ID	LABEL	TA STATEMENT	LOC	F	JKB	Y	NOTES
*	01416	JULIANDAY	0	01415	00000	00000		
*	01417	IMPERIAL	0	01416	00000	00000		
*	01418	TAPEBLOCK	0	01417	00000	00000		
*	01419	SLØTBLOCK	0	01420	00000	00000		
*	01421	TAPESEARCH	0	01421	00000	00000		
*	01422	RAAD	0	01422	00000	00000		
*	01423	DECAD	0	01423	00000	00000		
*	01424	DISTAD	0	01424	00000	00000		
*	01425	RADIFAD	0	01425	00000	00000		
*	01426	DECDIFAD	0	01426	00000	00000		
*	01427	DISTDIFAD	0	01427	00000	00000		
*	01428	SAFE	0	01430	00000	00000		
*	01429	AEPHEM	RESERVE 8630	01431	00000	00000		
*	01430	LASTEphem	0	03170	00000	00000		
*	01431	RESERVE 1		03171	00000	00000		
*	01432			03172	00112	30264		
*	01433			03173	00112	32007		
*	01434			03174	31050	00005		

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